ULTIMA®
MOTOR WORKS

ENGINE OWNERS MANUAL

SHOVELHEAD ENGINES

***NOT EPA COMPLIANT**

ULTIMA COMPANY LLC

Ultima Company LLC is not a representative of any other motorcycle manufacturer and the parts we sell are not necessarily recommended by any other motorcycle manufacturer.

All words used in this catalog denoting any motorcycle manufacturer, models or motorcycle, or part numbers are intended for use as reference only.

Although our replacement engines are not original factory equipment for some manufacturers, our intention is to provide an exceptional quality replacement part that will outperform the original equipment of many OEM manufacturers.

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The following model designations for Harley-Davidson® motorcycles are used in this catalog for reference only: EL, FL, FLH, FLHR, FLHS, FLHT, FLHTC, FLHTC-I, FLHTC Ultra Classic, FLHX, FLST, FLSTC, FLSTF, FLSTN, FLSTS, FLT, FLTC, FLTC Ultra Classic, FXB, FXD, FXDB, FXDC, FXDG, FXDL, FXDS, FXDS-Conv., FXDWG, FXE, FXEF, FXLR, FXR, FXRC, FXRD, FXRDG, FXRP, FXRS, FXRSE, FXRS-Conv., FXRS-SP, FXRT, FXS, FXSB, FXST, FXSTC, FXSTS, FXSTSB, FXWG, GE, K, KH, WL, WLA, XL, XLCH, XLCR, XLH, XLH 883, XLH 1100, XLH 1200, XLR, XLS, XLT, XLX AND XR-1000.

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WARNING

Serious injury, death and property damage can result from the improper use, control, alteration, or maintenance of motorcycles. The dealer and dealers customers must exercise good judgement in the use, control, alteration, part selection and installation, and maintenance of motorcycles. Ultima® has no control over the judgement of others and assumes no responsibility or liability of any nature for the failure of others to use good judgement.

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ULTIMA® SHOVELHEAD ENGINES

DISTRIBUTED EXCLUSIVELY BY MIDWEST MOTORCYCLE SUPPLY

Failure to read and comply with this document completely may Void Warranty.

SHOVELHEAD ENGINE WARRANTY:

Ultima's Complete Assembled Shovelhead engines are guaranteed to the original purchaser to be free of manufacturing defects in materials and workmanship for a period of 6 months/6,000 miles from the original date of purchase.

Merchandise that fails to conform to these conditions will be repaired by Ultima if the parts are returned to Midwest Motorcycle Supply by the purchaser within the specified warranty period or within 10 days thereafter. **Cost associated with removing or installation of complete engines are not covered under this warranty. This warranty covers Ultima® parts only and no other associated expenses.**

In the event that any warranty service is required, the original purchaser must call or write Midwest Motorcycle Supply immediately with the problem. Many problems can be rectified by a telephone call and need no further course of action. Merchandise that is suspected of being defective must not be replaced by a Dealer or End User without prior authorization from Midwest Motorcycle Supply. If it is deemed necessary for Ultima to make an evaluation to determine whether the part was defective, it must be packaged properly to prevent further damage and be returned prepaid to Midwest Motorcycle Supply. You must include a copy of the original invoice and a detailed letter outlining the nature of the problem. You must also outline how the part was used and the circumstances at the time of failure. If, after an evaluation has been made by Ultima and the part was found to be defective, repair to the existing part or replacement will be granted **at Ultima's discretion**. Engines that have been modified in any way from the original purchased configuration will void the warranty.

ADDITIONAL WARRANTY PROVISIONS:

1. Ultima® shall have no obligation in the event an Ultima® part is modified by any other person or organization.
2. Ultima® shall have no obligation in the event an Ultima® part becomes defective in whole or in part as a result of improper installation, improper maintenance, improper use, abnormal operation, or any other misuse or mistreatment of the Ultima® part.
3. Ultima® shall not be liable for any consequential or incidental damage resulting from the failure of an Ultima® part, the breach of any warranties, the failure to deliver, delay in delivery, delivery in non-conforming condition, or for any other breach of contract or duty between Ultima® and a customer.
4. Ultima® parts are designed exclusively for use in Harley-Davidson® type motorcycles. Ultima® shall have no warranty or liability obligation if an Ultima® part is used in any other application.

For any warranty issues please contact: Ultima Company LLC • 2100 Highway Z, Pevely, MO 63070 • 314-773-3064 • tech@midwestmc.net

General Specifications 96”

Displacement CI	96Ci		
Displacement CC	**1564**		
Bore	3.625”	Rod Length	7.440”
Stroke	4.625”	Flywheel	Forged 5Pc
Compression	9.5:1	Case Spigot bore	3.880”
Valve : Int	1.940”	Pump Type	92 and later
Valve: Ex	1.750”	Breather Type	Case/Timed Gear
Cam Duration	256/256	Cam Cover Type	91 and earlier
Pushrod Length	Adjustable	Rocker Box Type	Stock
Piston	2618 Forged	Rocker Arm/ Ratio	1.5
Cylinder Length	5.530”	Engine Height	.200” Taller
Case Deck Height	5.375”	Est. Rated power RW	90hp/95tq
Engine Weight	170 Lb		

Cam Information

96 CI engine:

Timing information is Open/Close @ .053

Int 24/52	**Ex** 52/24
256 Dur	256 Dur
Lift .450	Lift .450
TDC .156	TDC .156

Installation Notes:

Ultima® Engines must be installed by a trained professional mechanic into a motorcycle for which its use was intended. Failure to do so may result in injury and even death. It is the customer’s responsibility to insure their mechanic has proper training.

Fitment and Clearance Issues:

Every effort has been made to insure these engines will install into most available frame models without modifications.

Oil Pump Fittings Identification:

Ultima® Shovelhead engines use a 1992 & later style oil pump as shown in Figure 2.

1. The feed line is mounted in the center of the outer cover of the pump and is pointing up.
2. The return line is mounted to the very bottom of the outer cover and is pointed forward. This line goes to the Filter Input. See Figure 5.
3. The Crank case vent is mounted to the engine case just above the oil pump.
4. The feed line can be moved by removing the plug at the bottom of the outer pump cover and reinstalling the fittings.

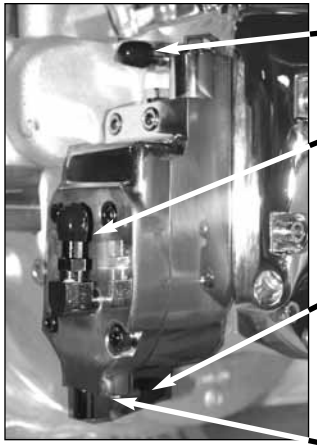


FIG. 2

Oil Line Routing

Figure 3 Tank cutaway shows the oil line identification for Stock FXST® type tanks and Ultima® brand FXST® type oil tanks.

Figure 4 Tank cutaway shows the oil line identification for Ultima® brand round oil tanks.

As you can see, both tanks have an internal return line that goes to the far side of the tank to improve oil circulation. If you are using this type of tank you must have the return line connected to the correct fitting. **NEVER ASSUME YOUR OIL TANK IS CLEAN ENOUGH.**

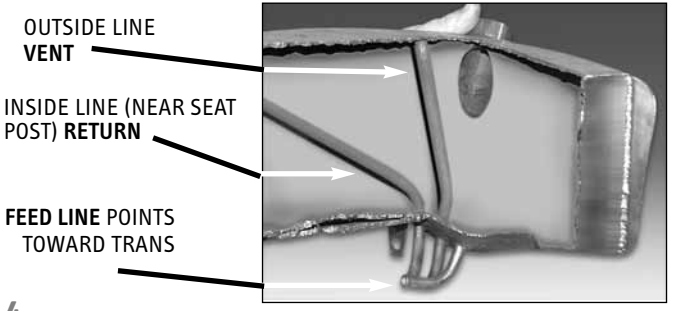


FIG. 3

THESE LINES MUST BE CONNECTED PROPERLY TO THE OIL TANK AND FILTER HOUSING OR ENGINE FAILURE CAN OCCUR!!!

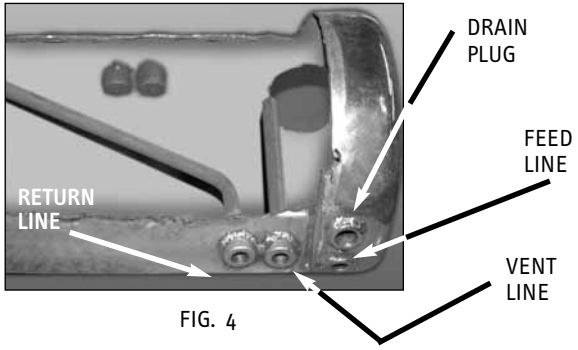


FIG. 4

Oil Recommendations

For break-in and standard operation of the Ultima Shovelhead engine we recommend using high quality petroleum based API service SJ rated motor oils, such as Ultima's 60 weight oil, MW# 103-111. The oil's viscosity should be matched with the climate conditions but in most cases Ultima 60 weight motor oil will work fine.

Oil Filters

All Ultima® engines require oil filters. Oil filter mounting bolts are located on the right side of the engine case made to accept 92/99 FXST® style filter mounts. When using this type of filter housing make sure the lines are routed as shown in Figure 5. Any of our high quality 40 Micron Ultima®/Evolution style filters can be used with any style of filter mount.

Oil Coolers

Ultima recommends oil coolers in applications where heavy loads are pulled or ambient temperatures exceed 90˚F or oil temps exceed 240˚F. When choosing an oil cooler, it is best to choose one that is finned & forward mounted on the frame. When using oil coolers in cold temperatures, either install a thermostat or a cover to insure the oil temperature makes it to a minimum operating temperature of 180˚F.

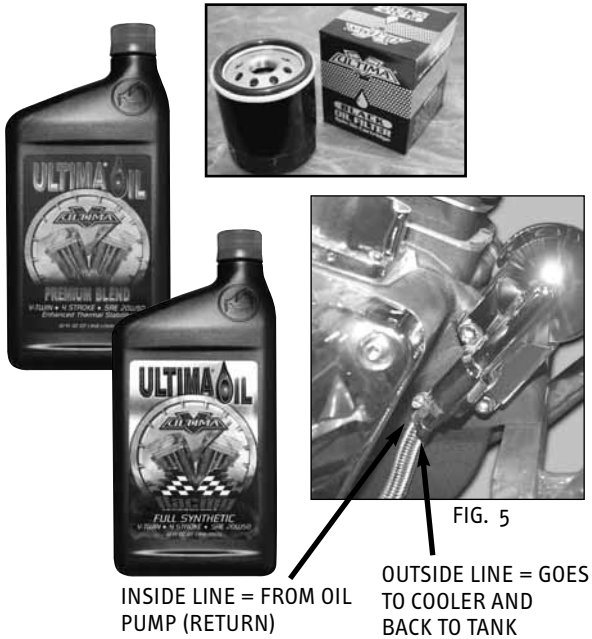

ULTIMA OIL
PREMIUM BLEND
ULTIMA OIL
FULL SYNTHETIC
INSIDE LINE = FROM OIL PUMP (RETURN)
OUTSIDE LINE = GOES TO COOLER AND BACK TO TANK

FIG. 5

Charging system selection

Ultima® engines are supplied with MW part #98-360 main seal spacer for use with 32 amp charging systems. This spacer was used on most 19 through 32 amp-charging systems supplied on Shovelhead® and Evolution® engines (except 1995 & later FLT®). If you use a higher output 38, 40 or 44 amp system you must change the spacer to that system's specific spacer or the Stator Rotor will contact the crankcase. You will also have to replace the engine main seal, MW# 95-805. All charging systems are available through Midwest Motorcycle Supply.

General Information

Compression Release Valves

All Ultima® Shovelhead engines are supplied with manually operated push button compression release valves. These valves aid in starting your engine and can greatly increase your starter and battery life. To operate these simply depress the Top Cap as shown in Figure 1 and they will pop back up automatically once the engine is cranking. These are designed to help the starter to begin spinning the engine by providing a small bypass hole to relieve compression as the engine is rotated. When the cylinder pressure overcomes the CR valves spring tension it automatically shuts. After prolonged use, valves can become sticky and closing can be slow. A slight blip of the throttle while the engine is running should shut the valves immediately.

FIG. 1

Clutch and Driveline Considerations:

When installing any performance engine you should consider upgrading your clutch and inspecting or replacing your Primary Chain and adjuster. Increased power levels and aggressive riding styles can cause stock or worn components to fail or work poorly and they may need to be upgraded. For custom applications, Ultima® recommends using industry proven Ultima® belt drives.

Primary Belt Drive Considerations:

When installing belt drives on Ultima engines it is recommended that RTV silicone be applied behind the stator where the casting meets the steel liner & between the crankshaft splines & the rotor spacer. Be sure to clean area thoroughly beforehand to insure adhesion & curing of the silicone. **See Fig 1. & Fig 2.**
After applying the silicone. Install the stator onto the motor case. It is also recommended that a liberal amount of blue loctite (med. Strength) be applied to the stator bolts. **See fig 3. & 4.**

FIG 1.

FIG 2.

FIG 3.

FIG 4.

Gearing Considerations:

When installing a performance engine selecting the proper gearing is very important in achieving the performance levels you desire. In many cases engines with less power that are geared properly can outperform more powerful engines that are geared poorly for particular applications. Another important factor is gross vehicle weight. Motorcycles that are heavy should not be geared with highway gears and a Six Speed unless the engine used is very, very powerful. On these types of bikes a 3.2-3.37 ratio will give much better acceleration. On most late model motorcycles the factory gearing is a good choice for all around riding. In lighter bikes we recommend a 2.92 to 3.15 overall ratio for highway riding. On heavier bikes used for highway riding or lighter bikes wanting quick acceleration for around town riding use 3.23 to 3.37 overall ratio. The following rpm/mph figures are based on a rear tire diameter of 26" or 12.5" from the ground to the center of your axle. Changing tire diameter 1" = approx. 2.6 mph.

Some common gear ratios are:

Stock 1995 FLH® models	36t clutch basket divided by 25t engine sprocket = 1.44 70t rear pulley divided by 32t transmission pulley = 2.19	1.44 x 2.19 = 3.15 overall 3000 rpm @ 74mph
Stock 1995 Softails®	36t clutch basket divided by 25t engine sprocket = 1.44 65t rear pulley divided by 32t transmission pulley = 2.03	1.44 x 2.03 = 2.92 overall 3000 rpm @ 79mph
Stock 1991 all models	37t clutch basket divided by 24t engine sprocket = 1.54 70t rear pulley divided by 32t transmission pulley = 2.19	1.54 x 2.19 = 3.37 overall 3000 rpm @ 69mph
Ultima® belt drives with chain rear	71t clutch basket divided by 45t engine pulley = 1.6 48t rear sprocket divided by 24t transmission sprocket = 2	1.6 x 2 = 3.20 overall 3000 rpm@ 73mph

Exhaust System Selection

Ultima Shovelhead motors utilize a 3-bolt exhaust mount for added durability, but stock single-bolt exhaust can be used. When selecting exhaust systems avoid large diameter pipes that do not have a smaller primary pipe that exits the head for at least 4-8". Overall the owner's satisfaction of the selected pipe is most important but it can also have a negative effect on rated power levels. For peak power levels a good stepped exhaust (1-3/4" Primary 4"-8" long to 2" pipe 12"-16" long to 2-1/4" pipe for the balance) drag pipe 32"-38" long will yield the highest numbers. For all around rideability select a free flowing staggered dual muffler set or the 2 into 1 systems. There are many exhaust systems out there with just as many opinions on what works. Contact your exhaust manufacturer for suggestions on which exhaust system would best work for your size engine.

Starter and Battery Considerations

Ultima® Shovelhead engines will typically have no starting problems when using components with comparable power ratings as used on OEM motorcycles built after 1989. Ultima® starters, batteries & battery cables are recommended when upgrading from the stock components. Typically an Ultima Thunderfire® starter with a 1.4 to 1.75kw rating when used with an Ultima® AGM battery & high quality Ultima® cables will give the best performance on our Shovelhead engines.

ULTIMA® THUNDERVOLT AGM HIGH POWER BATTERIES

ULTIMA® PREMIUM BATTERY CABLES

ULTIMA® THUNDERFIRE HIGH OUTPUT STARTERS

Ignition Systems

Ultima® Shovelhead engines come with an Ultima Fixed Curve **Single Fire Ignition System** (by Dynatek) with advance Curves and the Rev Limiter preset from the factory and do not require further adjustment. Rev limiter is set at 6,000 RPM. **Modifying or tampering with the ignition settings during the engines warranty period will result in your warranty being void.**

Ultima® Shovelheads utilize a dual plug design to prevent detonation, overheating, spark plug fouling and hard starting. Additional horsepower and increased gas mileage are also benefits of the dual plug design.

It is recommended, yet not required, to run both plugs per head. If you choose to run dual plugs please refer to **dual plug wiring diagram** on the next page.

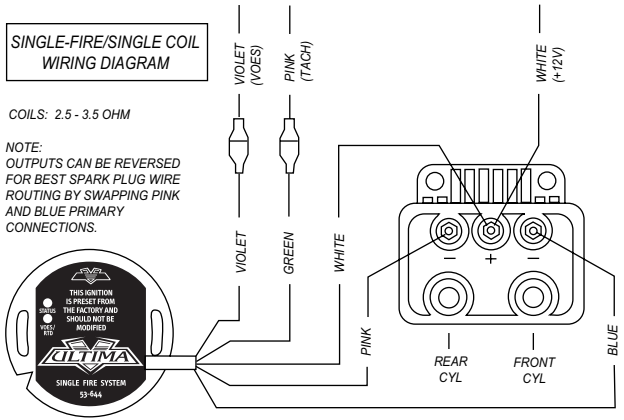
• INSTALLATION NOTES

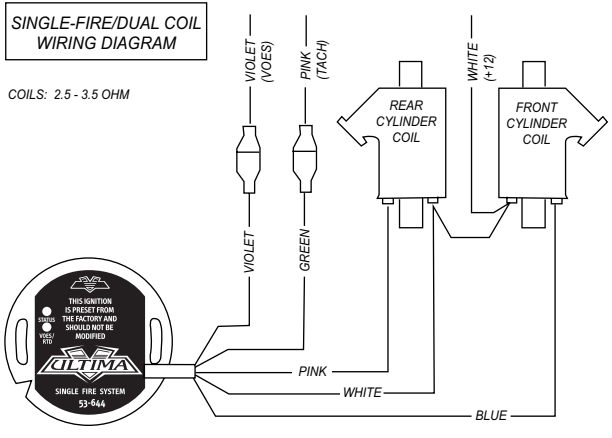
****IMPORTANT**** Coil primary resistance must be in the range of 2.5 to 3.5 ohms.

****IMPORTANT**** Carbon, graphite or spiral core type suppression spark plug wires are required. Do not use metal core wires. Ultima® high performance spark plug wires w/300 ohms of resistance per foot produce the best results when using an Ultima® ignition system.

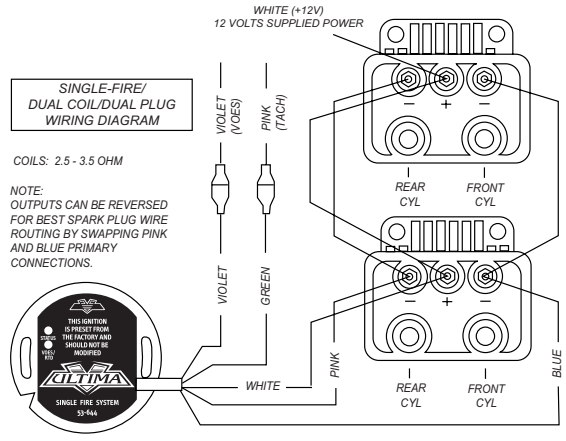
****IMPORTANT**** This Ultima Ignition requires the gold colored timing rotor used on 1983 and later EVO® motors (Midwest part no. **53-14**). The earlier silver colored cup will not work properly. Bikes originally equipped with points (except distributors) or early electronic ignition will accept the later model cup without modification.

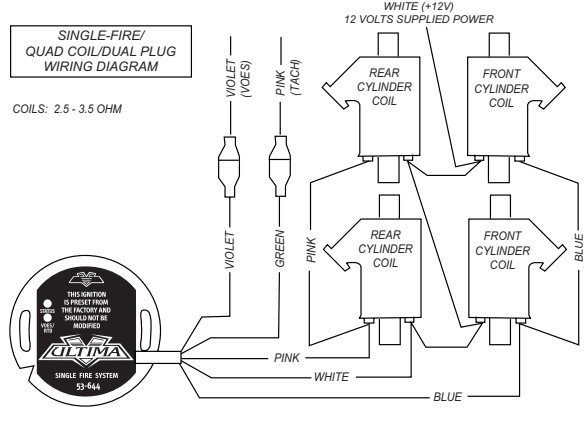
SINGLE PLUG WIRING





DUAL PLUG WIRING



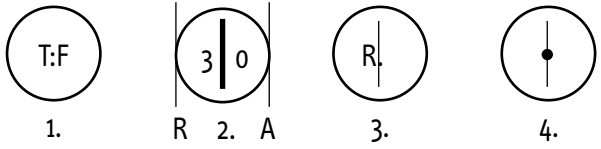


Setting Aftermarket Ignition Systems

These instructions are provided for professional mechanics when replacing the OEM Ultima® fixed curved ignitions after the warranty period expires. **Installing aftermarket ignitions during the warranty period on any Ultima® Shovelhead engine will void your warranty.** (For TOTAL TIMING use the information supplied in this book and not from any ignition manufacturer other than Ultima®.)

Timing Marks

Ultima® Shovelhead Engines are supplied with 4 reference timing marks on the flywheel to identify crankshaft location when viewed through the timing hole plug. These marks are as follows:



Mark 1. = (T:F) **T**op **D**ead **C**enter on the **F**ront cylinder—**The TDC mark is used for most electronic ignitions as the reference point to begin the static timing process**. When using this mark for timing you must be on the compression stroke on the front cylinder and both valves should be closed. This mark is also used when checking total timing with a Dial Back type timing light.

Mark 2. = (NOTE 1) Advanced Timing mark for the front cylinder — This mark is used for ignitions that have mechanical advance weights as the reference point to begin the static timing process. **(You must still rotate the point cam or trigger rotor to full advance to use this mark and static time properly.)**

This mark is also the reference when using a regular timing light to check total timing **for all ignitions**. When checking timing with a light you must use the front cylinder plug wire and turn off any multi spark functions your ignition may have. You must also rev the engine high enough to bring the system to full advance to check properly. Some ignitions have very slow curves that may require you to rev the engine to 5000 rpm before it gets to full advance. **We do not recommend these**. Instead we prefer to select a point from the manufacturers' advertised curve at 3000 to 3500 rpm max to **verify this type of curve**. This can give you an idea of how close the curve is to advertised data. On larger cubic inch engines the total timing is very important to engine life and performance. If your ignition does not meet the advertised curve be very cautious and replace or reset the part immediately.

Mark 3. = (R) (NOTE 1) Advanced timing mark for Rear Cylinder. This mark is only a reference **and is rarely used** for ignition timing. Some ignitions offer an adjustment for rear cylinder and front cylinder timing spreads where this mark can be useful. An example of this is a Dyna S single fire ignition and Crane HI4. We recommend you verify the rear cylinder timing if using these ignitions.

Mark 4. = (●) TDC on the rear cylinder. **This mark is rarely used for ignition timing** and is only listed as a reference for professional engine builders or when checking timing on the rear cylinder with a dial back type timing light.

Range of timing hole: Shown with Mark (2). When timing an engine with a 30˚ mark on the flywheel, if the mark is to the front of the hole the total timing is **R**etarded to 26 degrees. If the mark is to the rear of the hole the total timing is advanced to 34 degrees. When in the center of the hole this mark represents 30 degrees of advance for the front cylinder. This can also be useful when using certain ignitions on larger engines where the slowest curve still advances the timing past the recommendations below. Many Electronic Ignitions have good curves but with too much total timing. You can retard the base timing and change the entire curve by moving the TDC mark to the **R**etard side of the timing hole prior to the static timing process to make the advertised curve produce the desired total timing. When setting the timing on any engine we recommend using a timing light to verify the ignition timing is accurate.

Initial timing of the ignition system

Engine Displacement	**96”**
Total Timing @Full Advance	**32-34**

With the variety of ignitions available it is difficult to explain this process for all ignitions. **If you do not have instructions for your ignition please contact the manufacturer and get this important information.** Some of these are listed at www.ultimaproducts.com.
On ignitions such as Ultima®, Crane, Dyna 2000 and Compu-Fire that have adjustable advance curves, do not select the most aggressive curves for break in. On some Ignitions only a few curves offered will provide the proper timing at full advance and some will advance more than 26-28 degrees on the least aggressive curve. **If you cannot get the full advance timing needed, shown in the chart above, you will need to retard the base timing the amount needed or replace the unit with one that has the proper total timing at full advance..** We have found in most cases these Ultima Shovelhead engines will accept full timing before 2500 rpm and this is the best choice for most engines. If you have excessive Spark Knock or detonation go to a slower curve, Colder Spark Plug, Richer Jets or better fuel. Whatever tuning you need to do to get rid of this condition must be done. Higher elevations typically require more advance timing than lower elevations. Use the chart above for the range to stay within.
If you have any doubt that your timing is not set correctly or that your ignition system may be faulty have it checked by a professional Mechanic and bring this booklet in for their reference.

After your engine’s break in procedure has been strictly adhered to we recommend that you have your engine dyno tuned with timing and advance curves set for optimum performance and reliability.

Example for settings on **Ultima & Dyna 2000i Programmable Ignitions**

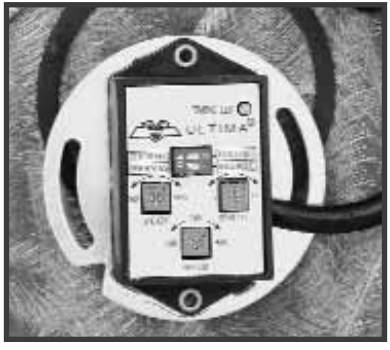
1. **Follow the Manufacturers instruction to set the Static timing** and understand the instructions. **Make sure you have the engine on TDC (TF on the Flywheel) on the Front Cylinder on the compression stroke before you begin.**

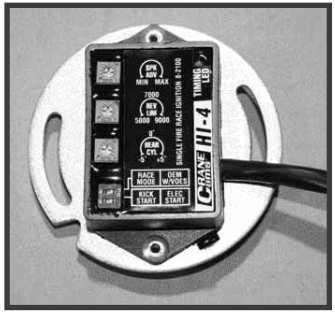
2. Set the ignition to the Normal VOES mode but do not install the VOES switch. Instead tape up the wire (violet) — Do NOT Ground this wire.

3. Set the Rev Limit to Minimum for Break-in. (Switch 4 & 5 off)

4. Look in the Manufacturers instructions at the Curves produced by the ignition when in the Normal VOES mode. Look at the curves you will get when no VOES switch is present. The instructions show 4 different advance curves for this scenario. Select the curve with the proper total timing shown in this book for your engine. Ultima Ignitions have preset curves and will get you close by static timing the engine at TDC. Dyna 2000 Ignitions will require you to modify the base timing on most engines so the total advance is not too excessive. Refer to “Range of timing hole”, earlier in this booklet. Read and understand ignition manufacturer settings before running your engine. Both Ultima and Dyna 2000 2KI Ignitions can be custom programmed using a tuners kit.

Example for settings on **Ultima SF Hi-Perf. & Crane HI4 Ignitions**





1. **Follow the Manufacturers instruction to set the Static timing** and understand the instructions. **Make sure you have the engine on TDC (TF on the Flywheel) on the Front Cylinder on the compression stroke before you begin. The ignition will be nearly vertical — slightly to the 1 o'clock position if you got it right.**

2. Set the ignition to the OEM with VOES mode but do not install the VOES switch. Instead tape up the wire — Do NOT Ground this wire on the HI4 System or Ultima ignition system.

3. Put the ignition in Kick Start Mode as they will fire on the first revolution and typically start much easier this way.

4. Set the Rev Limit to Minimum for Break-in.

5. Set the Rear Cylinder Advance to "0".

6. Look in the Manufacturers instructions at the Curves produced by the ignition when in the OEM with VOES mode. Look at the Low vacuum
set of curve as this is what you will get when no VOES switch is present. The instructions show a MAX advance curve and a MIN advance curve for this scenario. When you turn the Spark Advance dial on the face of the ignition to MIN you will get the curves shown as MIN and as you turn the dial towards MAX you will get something linear between MIN and MAX. As you can see the MIN is around 26 degrees and the MAX is about 30 Degrees full advanced.

Rev Limiters

During break-in we suggest setting Rev Limiters to the lowest setting (5,500 or less) to insure over revving will not occur. Most Ultima® engines will not produce power beyond 6,000 rpm and little if anything is gained by revving these engines past this rpm when in the stock configuration. **A major contributor to a shortened engine life is high RPM.**

Spark plugs Recommendations:

There are a variety of spark plug manufacturers who make the proper style and heat range plugs for the Ultima Shovelhead engines. Engines that have excessive spark knock may require a colder heat range and or richer air/fuel mixtures and retard the timing. We also recommend using the coldest plug your combination/environment and fuel will allow for best overall engine life and performance. Plugs that are too cold may foul easily under certain conditions and plugs that are too hot can cause spark knock and detonation. Some popular manufacturers and heat ranges are listed below. Follow your plug manufacturer's recommendations for proper plug gap.

12mm Cold Plug		**12mm Colder Plug**
Champion	RA8HC	RA6HC
Autolite	4164	4162
NGK	DCPR7E	DCPR8E
Accel	882	742

Ultima Shovelhead engines are supplied with Champion RA6HC spark plugs installed and gapped at .035".

Baseline Jetting Suggestions

Mikuni 42mm	160/22.5
S&S 'E'	76/31
S&S 'G'	74/29.5

Carburetors and Initial Tuning

Ultima Shovelhead engines are not supplied with a carburetor or intake manifold. It is the responsibility of the original purchaser to choose the best carburetor for their riding needs. It is also the responsibility of the original purchaser to insure that their carburetor is properly tuned. Typically higher elevations or hotter climates will require different jetting and ignition timing than those shown in this guideline. At any elevation it is important that your initial tune is not excessively rich, which is indicated by excessive black smoke, and equally important, avoid running the engine lean for the initial break in as this condition creates heat fast. Prior to starting your engine you should check your carburetor's initial idle mixture setting and fuel pump setting recommended by the manufacturer. Ultima® provides the proper base line jetting for typical carburetors that will be used, but idle mixture and fuel pump settings must be done on an individual basis. When selecting the initial jetting for your engine remember that exhaust systems and ignition settings can have a great effect on the engine's fuel demands. **An experienced tuner** should make the final decision for your particular jetting and timing needs with your combination and at your elevation. Thoroughly read and understand your carburetor instructions before installing it or starting your engine.

START UP AND BREAK IN RECOMMENDATIONS

To give your engine maximum life and performance please read these recommendations thoroughly. These recommendations are assuming that your engine has been installed by a professional mechanic and all aspects of proper engine installation have been addressed.

Pre-Start Checks

Oil System:

Some things that you should not do prior to starting your engine are:

1. Never assume your oil tank is clean enough:
   Oil is your engine's life blood and installing a new engine in a motorcycle that has not had the oil system (tank, cooler, filter housing) thoroughly cleaned with new oil lines installed is definitely something not to do. All new tanks and coolers should be inspected and cleaned prior to installation.
2. Never assume your oil lines are on correctly:
   Double check that your feed line, return line and crank case vent line are routed to their proper fittings. If you are unsure contact the components manufacturer or professional mechanic for proper routing.
3. Never run your engine without an oil filter installed. Oil filters prolong engine life and are a must for performance engines.

Priming the oil system prior to Start-up

All engines should be checked for oil pressure prior to start up. Oil pressure should be visible at the top end feed screen plug, which is located to the rear of the rear lifter block on the cam cover side. See Figure 6.

To verify that you have pressure before running your engine follow these steps:

Make sure you have filled your oil tank with clean engine oil and no oil lines are crimped.

1. Remove the top end feed screen plug.
2. Disconnect all wires from the coil.
3. Remove spark plugs from engine.
4. With the motorcycle in neutral, turn on the ignition and crank the engine in 5 second intervals until oil pressure is present at the top end feed screen plug. If oil pressure is not visible repeat this process until oil is present. After oil is present reinstall the top end feed screen plug.
5. Continue to crank the engine for approx. 20 seconds total. You will now have oil to the lifters and can start the engine.

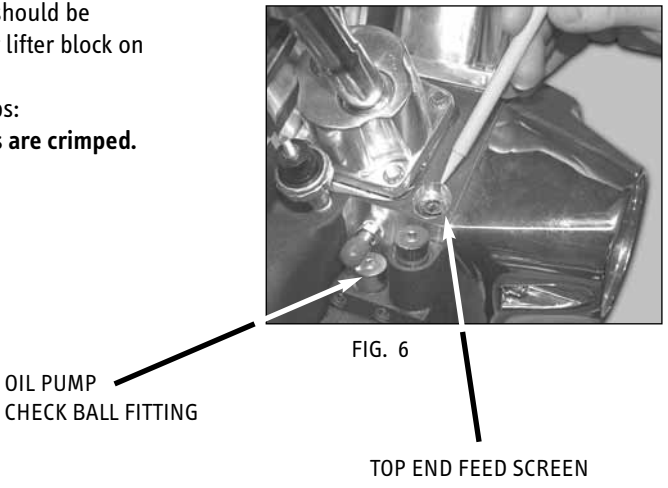


FIG. 6

Note: If you have difficulty priming your engine's oil pump you can remove the oil pump's check ball (see Figure 6) and fill the check ball cavity with engine oil and then reinstall the check ball. By doing this you are removing air pockets in the pump and flooding the pump's feed gears with oil. Generally this will greatly speed the priming process.

Fuel Recommendations:

High quality fuel will have a direct effect on your engine's performance.

Ultima® Shovelhead engines are designed to run on a Minimum of 92 octane unleaded fuel. Higher octane fuels will be beneficial to your engine only up to a point and above about 100-105 octane you can lose performance as the engine's fuel requirements and ignition timing requirements with these fuels will change. Search out the best fuels in your area. There are large variations in fuel quality nationwide.

Initial Start Up

One of the most important parts of the break-in procedure is the initial starting of your engine!!!!
Read this completely before starting the engine!!!!!!

1. Remove the Air Filter Cover.
2. Twist the throttle wide open and make sure that the accelerator pump is working.
3. Give the engine 2 full fuel squirts and full enrichment or choke.
4. Leave the throttle shut and start the engine.

Upon start of the engine, immediately set the idle at approx. 1000-1200 rpm and let the engine idle while initial idle mixture or air bleed settings are adjusted, if needed, to allow the engine to idle properly.

Some of the things you should not do to a new engine are:

- **Do not start the engine without first going though the oil pump/lifter priming process described earlier.**
- **Do not start the engine without a large fan pointed at the engine and on its highest setting.**
- **Do not rev the engine or blip the throttle repeatedly.**
- **Do not let the engine idle for long periods.**

While these things may seem unimportant please consider that new engines create much more heat than engines that have been broke in. Remember these are **Air Cooled engines.**

On the initial start we recommend letting the engine run approx. 2 minutes then letting it cool before repeating this procedure. Do overall checks before restarting. Do not over heat the engine! For each 2 minute cycle, run the engine at idle 10-15 seconds then at 2000-2600 rpm for 10-15 seconds. Check and verify that your engine has adequate oil pressure and is returning oil to the oil tank.

After you have run the engine for approx. 4-5 minutes, verify that no intake air leaks or oil leaks are present.

Do not let the engine get excessively hot! You can now T**AKE YOUR FIRST RIDE!**

Break-in procedures for Ultima® Engines

Follow these guidelines closely or you may void your warranty.

Avoid over heating your engine!!!!!!!!!!!

The heat of a new engine can be directly related to engine rpm, load and friction.

Do not lug the engine. If you have a 6-speed transmission do not run your bike in 6th gear during break-in. We strongly recommend you keep the engine rpm above 2400 and below 3500 rpm for the first 500 miles and run the engine at varying speeds. Setting the Idle at a minimum of 900-1100 rpm during break–in is desired.

Short trips under 10 miles **and not in traffic** on the first 2 rides are preferred. Try to ride on cool evenings and do not idle the bike very long. Keep air moving around the engine to keep it cool. Making the next 3-4 trips fewer than 30 miles will help to keep the heat down. When taking your initial rides on your new engine do so riding solo **to avoid lugging the engine. If the engine feels like it is getting excessively hot shut it down** and let it cool. Typical engine oil operating temperatures are 180°F-225°F degrees and should not be exceeded.

If an engine overheats during break-in due to improper ignition timing, improper jetting, or excessive heat you can collapse or (stick) a piston which may not be covered under warranty.

During the first 500 miles of operation we highly recommend running the engines on open road at varying engine speeds. If you have an oil temperature gauge try to keep your engine oil temperature below 220°F degrees even after break-in.

For the first 1000-1500 miles you should monitor your engine temperature and **always avoid prolonged idling or sitting in traffic. If you get stuck in traffic pull over and take a break. DO NOT break-in your engine at Daytona or Sturgis or any other rally.**

After 2000 miles avoid running your engine above 6000 rpm and if your ignition has a rev limiter, set it to work at this RPM. In most stock Ultima® engines no additional power is made above 6000 rpm and running the engines at these higher rpm's will only shorten engine life especially on poorly tuned engines.

Break-In Service and Hardware Re-torquing

With a new engine we feel the first oil/filter change should occur after the first 50-100 miles and all cover bolts and engine-mounting bolts should be checked for proper torque. Keeping your engine oil clean is very important to the overall life of the engine. During the Break-In, or look at it as the "Wear-In" period, engines produce very small metallic pieces that need a good filter to remove them. We do not recommend extremely fine 10-micron filters during this time as they can clog quickly and begin to by-pass oil instead of filtering it. Use the 40 Micron Filters during break-in and for the life of the engine. Ultima® recommends Ultima® Oil Filters, some examples are Midwest part# **25-78 & 25-79**. Checking cover bolts and engine mounting bolts is just good preventative maintenance during this period.

Dyno Tuning

After your engine's break-in procedure has been strictly adhered to we recommend that you have your engine dyno tuned for optimum performance and reliability. Typically a new engine will have different fuel demands than an engine that has been through the break-in procedure and additional tuning may be required for optimum performance and reliability.

Troubleshooting

Below you will find a list of common issues we have encountered with new engine installations. If you do not see your problem or cannot resolve one of these problems please contact your dealer for more information.

Engine Won't Start

Common causes: **1.** No fuel supply. **2**. No spark. **3.** Engine has been flooded.
When trying to start the engine for the first time, and it is difficult, you need to verify that you have compression, fuel and spark. If you remove the air filter cover and give the throttle 1-2 full turns prior to starting you can see if the accelerator pump is working properly and that fuel is being delivered. Please refer to the Carburetor manufacturers instruction on how to set the accelerator pump. After you give the engine a few squirts from the accelerator pump, give it a full enrichment or choke for best initial starting and do this **with the throttle closed.** Do not keep twisting the throttle if the engine does not start. Stop and evaluate the problem or you can Gas Foul the spark plugs. If no spark is present verify all connections and contact the ignition manufacturer for technical help.

Oil blowing out of Lower End/Case Breather Vent:

Common causes:

1. Oil tank is over filled.
2. Oil Tank vent lines and return lines are crossed.
3. Oil filter lines are crossed or plugged.
4. Filter has a check valve and lines are crossed (this will sometimes cause the filter to burst).

Typically this problem occurs when either the engine is not returning oil or the crankcase vent is not open to the oil tank. The most common cause is when Softail® style tanks are used and get over filled. Do not fill these tanks up to the bottom of the filler. Most tanks have oil lines internally that bring the vent and return to the top side so it will be in airspace and not immersed in oil which is very important to be correct. Some tanks have the return side routed to the far side of the tank to improve oil circulation. These tanks must have the return line on the proper hose barb or when they are hooked up as a vent they can be immersed in oil when on the kickstand which can also cause the problem. Also be careful of oil filter housings. If you have over filled your oil tank and have this problem you must drain the engine's crankcase before refilling. Ultima® Cases have a drain plug located at the bottom of the engine and you can drain the case if needed. When refilling the oil tank only put in about 2.5-3 quarts before starting the engine and add additional oil cautiously. Unfortunately it is hard to say how much oil your tank will hold without this happening again so if you experience this be precise on the amount you add to your tank on the refill during oil changes. We have seen some aftermarket housings that were not drilled from the factory causing the return side to be completely blocked. We have also seen directional filters, which will only work with oil flowing in the proper direction. Be sure that your filter and housing are routed properly and passages are not blocked.

Excessive lifter noise

Common causes: **1.** Engine was not properly primed prior to start-up. **2.** No oil feed to lifters. **3.** Improper pushrod adjustment. **4.** Oil lines are not connected properly.

If you have excessive lifter noise at start-up **shut the engine off immediately and go through the priming process described earlier in this document.** Ultima® engines are primed from the factory but if no oil is being fed from the oil pump the lifters will lose their prime quickly. Engines that are run with dry lifters are at risk to bend pushrods and can have permanent damage. Always check the pressure when diagnosing this with a quality pressure gauge reading from the oil-sending unit feed hole located behind the rear lifter block.

Refer to Figure 3 and 4, in the "Oil Line Routing" heading earlier in this booklet, or your oil tank's manufacturer regarding oil line connections to your tank if you are unsure. If you hook the oil lines up wrong you can damage the engine!! A good rule of thumb is the feed line is the lowest fitting in the oil tank and will pick up oil from the bottom of the tank. The vent line is the highest fitting and oil should never be able to reach the line inside the tank. The vent line has to be in airspace in the tank and never immersed in oil. The return line is also a fitting mounted high in the tank and can work in or out of the oil in the tank but should also be in airspace.

Lifter Adjustment procedure for Ultima® Engines

When performing any service work always disconnect the battery!!!

Remove the spark plugs and pushrod tube clips to access the pushrods. With a stable lift get the rear wheel of the bike off of the ground and put the bike in 5th gear. Use the rear wheel to rotate the engine slowly.

Never rotate the engine with the Starter motor while adjusting pushrods.

1. Rotate the engine until you are on the compression stroke for the cylinder you are adjusting. This occurs after the cylinder to be adjusted has had its **Intake** lifter go to full lift and back to Zero lift during forward rotation of the engine. At this time the piston will be coming up and both valves will be closed at Top Dead Center. Put the piston at the very top of its stroke (TDC). You can now adjust both pushrods for that cylinder.
2. Loosen both pushrods until there is play between the lifter and pushrod.
3. With your Fingers rotate the adjuster until there is no play between the lifter and pushrod (zero lash) but with no load on the lifter.
4. Extend the adjuster another **3 full turns** beyond zero lash and lock the jam nut tight. (This applies to pushrods with 18 threads per inch. If the pushrods are not the stock Ultima® pushrods use the manufacturer's recommended setting.)
5. Wait until you can turn both of the pushrods with your fingers (30 seconds to 15 minute wait). You can then roll the engine over and repeat the process for the next cylinder. **Do not roll the engine before you can turn the pushrods by hand or you can cause damage to the engine. The engine should rotate and not want to stop at any point when adjusting pushrods. If the engine wants to stop at any point do not force the rotation. Stop and reset that pushrod or you can cause damage to the engine.**
6. Repeat this procedure for the remaining pushrod for that cylinder.

General Torque Specs and Adjustments

Rocker Cover Nuts	12-15 ft lbs
Rocker Arm Shaft Locknut	12-18 ft lbs
Cylinder-Head Bolts	55-75 ft lbs
Cylinder-Base Nuts	32-40 ft lbs
Cam Cover/Lifter Block	1/4-20 bolts 120-150 In Lb
Oil Pump Bolts	120-140 In Lb
Pinion Gear Nut	42 ft lbs Left hand (reverse) thread
Case Bolts	All 5/16-18 bolts 14-18 Ft Lb — Torque 1/4-20 bolt last 90-110 In Lb
Inner Primary to Engine	22-25 Ft Lb
Alternator Plug Retainer	Use low strength threadlocker — Tighten to flush with crankcase machined surface.
Engine Sprocket Bolt	150-165 Ft Lb
Motor Mount bolts	34-38 Ft Lb
Spark Plugs	18-20 Ft Lb
Compression Releases	108-130 In Lb

MAINTENANCE SCHEDULE

First 100-150 MILE SCHEDULED MAINTENANCE

- ❑ Change oil
- ❑ Change oil filter
- ❑ Check fuel valve, lines & fittings for leaks
- ❑ Check oil lines & fittings for leaks
- ❑ Check torque of all fasteners

Technician Signature **Date**

First 500 MILE SCHEDULED MAINTENANCE

- ❑ Change oil
- ❑ Change oil filter
- ❑ Check fuel valve, lines & fittings for leaks
- ❑ Check oil lines & fittings for leaks
- ❑ Check engine mounting bolts

Technician Signature **Date**

First 1500 MILE SCHEDULED MAINTENANCE

- ❑ Change oil
- ❑ Change oil filter
- ❑ Check fuel valve, lines & fittings for leaks
- ❑ Check oil lines & fittings for leaks
- ❑ Check engine mounting bolts

Technician Signature **Date**

Ultima requires following the scheduled maint. guidelines every 3000 miles after the first initial 3000 miles. In an event warranty is needed, Ultima reserves the right to request copies of the signed scheduled maintenance lists. These guidelines are provided to give you maximum engine life, enjoyment & service life of your Ultima engine.

First 3000 MILE SCHEDULED MAINTENANCE

- ❑ Change oil
- ❑ Change oil filter
- ❑ Inspect & clean tappet screen
- ❑ Inspect & clean air filter as necessary
- ❑ Check fuel valve, lines & fittings for leaks
- ❑ Check oil lines & fittings for leaks
- ❑ Check torque of all fasteners

Technician Signature **Date**

MAINTENANCE SCHEDULE

6000 MILE SCHEDULED MAINTENANCE

- ❑ Change oil
- ❑ Change oil filter
- ❑ Inspect & clean air filter as necessary
- ❑ Check fuel valve, lines & fittings for leaks
- ❑ Check oil lines & fittings for leaks
- ❑ Check engine mounting bolts

Technician Signature **Date**

12,000 MILE SCHEDULED MAINTENANCE

- ❑ Change oil
- ❑ Change oil filter
- ❑ Inspect & clean air filter as necessary
- ❑ Check fuel valve, lines & fittings for leaks
- ❑ Check oil lines & fittings for leaks
- ❑ Check engine mounting bolts

Technician Signature **Date**

Ultima requires following the scheduled maint. guidelines every 3000 miles after the first initial 3000 miles. In an event warranty is needed, Ultima reserves the right to request copies of the signed scheduled maintenance lists. These guidelines are provided to give you maximum engine life, enjoyment & service life of your Ultima engine.

9000 MILE SCHEDULED MAINTENANCE

- ❑ Change oil
- ❑ Change oil filter
- ❑ Inspect & clean tappet screen
- ❑ Inspect & clean air filter as necessary
- ❑ Check fuel valve, lines & fittings for leaks
- ❑ Check oil lines & fittings for leaks
- ❑ Check torque of all fasteners

Technician Signature **Date**

15,000 MILE SCHEDULED MAINTENANCE

- ❑ Change oil
- ❑ Change oil filter
- ❑ Inspect & clean tappet screen
- ❑ Replace air filter
- ❑ Replace spark plugs
- ❑ Check fuel valve, lines & fittings for leaks
- ❑ Check oil lines & fittings for leaks
- ❑ Check torque of all fasteners

Technician Signature **Date**

CUT & DETACH HERE

SHOVELHEAD WARRANTY REGISTRATION CARD

THIS CARD MUST BE FILLED OUT AND MAILED TO THE ULTIMA WARRANTY DEPARTMENT WITHIN 30 DAYS OF ORIGINAL PURCHASE BY THE END USER.

ENGINE SERIAL #: _____

DISPLACEMENT: _____

DATE OF PURCHASE: _____

END USER: _____

PHONE NUMBER: _____

ADDRESS: _____

_____

_____

I, the undersigned, agree and understand that this Ultima® engine is not EPA compliant and is meant for competition and/or off-road use only. I also agree to & understand the warranty terms outlined in this Ultima® Owners Manual.

PURCHASER SIGNATURE _____ **DATE:** _____

AFFIX
STAMP
HERE

ULTIMA COMPANY., LLC
WARRANTY DEPARTMENT
2100 HIGHWAY Z
PEVELY, MO 63070